## 3.3.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

**Radiation Environment.** Major sources and levels of background radiation exposure to individuals in the vicinity of NTS are shown in Table 3.3.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to NTS operations.

***Table 3.3.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Nevada Test Site Operation***

| Source | Effective Dose Equivalent (mrem/yr) |
|---|---|
| **Natural Background Radiation** | |
| Cosmic and external terrestrial radiation[a] | 74 |
| Internal terrestrial radiation[b] | 39 |
| Radon in homes (inhaled)[b] | 200 |
| **Other Background Radiation[b]** | |
| Diagnostic x rays and nuclear medicine | 53 |
| Weapons test fallout | <1 |
| Air travel | 1 |
| Consumer and industrial products | 10 |
| **Total** | 378 |

[a] Derived from information on cosmic and terrestrial radiation given in EPA 1981b.
[b] NCRP 1987a.
Note: Value for radon is an average for the United States.

Releases of radionuclides to the environment from NTS operations provide another source of radiation exposure to individuals in the vicinity of NTS. Types and quantities of radionuclides released from NTS operations in 1993 are listed in the *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report–1993* (DOE/NV/11432-123). The doses to the public resulting from these releases are presented in Table 3.3.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment's (No Action) radiological releases and resulting impacts at NTS in the year 2005 (Section 4.2.2.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from NTS operations in 1993 is estimated to be $2.4 \times 10^{-9}$. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of NTS operations is about 2 chances in 1 billion. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, $6 \times 10^{-6}$ excess fatal cancers are projected in the population living within 80 km (50 mi) of NTS from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers expected during 1993 from all causes in the population living within 80 km (50 mi) of NTS was 44. This number of expected fatal cancers is much higher than the estimated $6 \times 10^{-6}$ fatal cancers that could result from NTS operation in 1993.

***Table 3.3.9–2. Radiation Doses to the Public From Normal Nevada Test Site Operation in 1993 (Committed Effective Dose Equivalent)***

| Members of the General Public | Atmospheric Releases | | Liquid Releases | | Total | |
|---|---|---|---|---|---|---|
| | Standard[a] | Actual | Standard[a] | Actual | Standard[a] | Actual |
| Maximally exposed individual (mrem) | 10 | 0.0048 | 4 | 0 | 100 | 0.0048 |
| Population within 80 km[b] (person-rem) | None | 0.012 | None | 0 | 100 | 0.012 |
| Average individual within 80 km[c] (mrem) | None | $5.5\times10^{-4}$ | None | 0 | None | $5.5\times10^{-4}$ |

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (see 58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] In 1993, this population was approximately 21,750.

[c] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: NT DOE 1994b.

The NTS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.3.9–3 presents the average worker, maximally exposed worker, and total cumulative worker dose to NTS workers from operation in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to NTS workers from normal operation in 1992 is estimated to be 0.0008.

***Table 3.3.9–3. Radiation Doses to Workers From Normal Nevada Test Site Operation in 1992 (Committed Effective Dose Equivalent)***

| Occupational Personnel | Onsite Releases and Direct Radiation | |
|---|---|---|
| | Standard[a] | Actual |
| Average worker (mrem) | ALARA | 2.6 |
| Maximally exposed worker (mrem) | 5,000 | 750 |
| Total workers[b] (person-rem) | ALARA | 2 |

[a] DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 780.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report–1993* (DOE/NV/11432-123). The concentrations of radioactivity in various environmental media (including air and water) and in animal tissue in the site region (onsite and offsite) are also presented in the same document.

**Chemical Environment.** The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.3.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements), contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at NTS via inhalation of air containing hazardous chemicals released to the atmosphere by NTS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.3.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to NTS workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NTS workers are also protected by adherence to OSHA and EPA standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operation processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, worker health conditions at NTS are expected to be substantially better than required by standards.

**Health Effects Studies.** The epidemiologic studies on groups surrounding NTS have concentrated on health effects in soldiers and children associated with nuclear testing rather than operation emissions. Results are contradictory regarding the observed leukemia incidence and deaths in exposed children, with some studies reporting excess, whereas others report no excess. Analytical methods used in some of these studies were questionable. For soldiers, the results regarding leukemia and polycythemia vera differ from two studies relating to nuclear test explosions. However, reanalyses showed leukemia, respiratory, and other cancers to be associated only with exposure to higher doses (for example, more than 300 millirem [mrem] for leukemia cases). For a more detailed description of the study findings reviewed, refer to Section M.4.3.

**Accident History.** Nuclear testing began at NTS in 1951. There were some 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1963. Since then, all nuclear tests have been conducted underground.

Since 1970, there have been 126 nuclear tests, which resulted in a release to the atmosphere of approximately 54,000 Curies (Ci) of radioactivity. Of this amount, 11,500 Ci were accidental due to containment failure (massive releases or seeps) and late-time seeps (small releases after a test when gases diffuse through pore spaces of the overlying rock). The remaining 42,500 Ci were operational releases. From the perspective of human health risk, if the same person had been standing at the boundary of NTS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure, or the equivalent of one-thousandth of a single chest x ray (OTA 1989a:4,5). [Text deleted.]

**Emergency Preparedness.** Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The *NTS Emergency Preparedness Plan* is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public. The plan integrates all emergency planning into a single entity to minimize overlap and duplication and to ensure proper responses to emergencies not covered by a plan or directive. The manager of the DOE Nevada Operations Office has the responsibility to manage, counter, and recover from an emergency occurring at NTS.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. The Nevada Operations Office receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current DOE Nevada Operations Office vulnerability assessments, resources, and capabilities regarding emergency preparedness.